Evaluating the Effectiveness of Educational Technology Investment in the Commonwealth of Virginia

V.E.T.A.C. Subcommittee
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Introduction

The Virginia Educational Technology Advisory Committee (V.E.T.A.C.) developed a series of position papers for the State Superintendent of Public Instruction in May, 1997. One of these papers was concerned with evaluating Virginia's *Six-Year Technology Plan*.. That paper recommended that the evaluation issue be addressed as a question of the potential for the Plan to facilitate the Commonwealth's progress toward its Vision for Technology in Virginia:

> Virginia students will be empowered to use current and emerging technologies for continued learning to become productive, creative citizens of the 21st Century (Virginia Department of Education, 1996).

That document recommended that the Department of Education approach implementing the Evaluation section of the Plan, and noted that "different ways to build accountability for the implementation and effective use of resources provided through the Plan need to be developed" (Johnston, Uhlig, and White, 1997). The purpose of the present report is to take the earlier effort yet another step forward.

Virginia has been committed to expanding the use of technology in its schools for a number of years. The first *Six Year Plan for Educational Technology* was one of the first the United States and was instrumental in establishing Virginia as one of the most forward thinking and innovative states in the nation. The Virginia Educational Technology Advisory Committee was formed to update and extend the first plan as it drew to a close. That task accomplished, V.E.T.A.C. has continued to provide a forum for discussion and to advise the State Superintendent and, through that office, the State Board of Education, on technology issues.

The legislature has also consistently voiced, and demonstrated, its commitment to educational technology for Virginia's students, allocating some $225,000,000 to technology initiatives during the 1996-98 biennium. With this funding, the Commonwealth has taken action as it has recognized the value of, and the need for, technology literacy and competence for its youth.

Virginia has also been in the forefront of the demand for accountability from its schools. The Virginia Standards of Learning (SOLs), which include Technology, are some of the most highly lauded sets of state standards in the country. Taking yet another step, the Commonwealth has also adopted new Standards of Accreditation for its schools; standards which require students to demonstrate competence on these SOLs in order to graduate from school and in order for the schools to be accredited by the State (Virginia Department of Education, 1996, 1997). It is not surprising, therefore, that the Commonwealth should want to know the impact that investments in technology are having on education. The purpose of the current report is to provide some background to this question and to suggest a structure to be used to achieve that end.

Background

Perhaps the most difficult questions to be asked relate not to whether investments in technology have an impact, but rather just what it is we are defining as "technology" and as "impact". Technology effectiveness has been evaluated in an incredible number of studies, most targeting a specific technology in specific situations. Integrated Learning Systems (ILS), video disks, distance learning technologies, different types of software (drill and practice, simulation, and so on), and may others have been put to the test. Some broad-based reviews of these studies report that they are generally supportive, others say that they are inconclusive (Sivin-Kachala and Bialo, 1998; ETS, 1997; From Now On, 1995). Further research and commentary, however, note that the question is really not so simple or so straightforward.

The effects of technology on learning are very difficult to ferret out of the malaise of variables that are intertwined with its implementation. In reality, the effectiveness question is complicated and "involves technology interacting with a multitude of other factors" (From Now On, 1995). It appears the technology assessments are really more "assessments of instruction enabled by technology", and that the results depend very heavily on how well the actual instructional design is put into practice (ETS, 1997). Different aspects of this mix have included changes in methodologies, grouping variations, time structures, the choice of software, the purpose of the instruction, and the societal mix in the classroom (ETS, 1997; Johnson, 1996; State of Washington, 1997).

It may be possible to summarize all of this into a statement made in "Using Technology to Support Educational Reform", a report published by OERI (USDoE, 1993):

> When used as part of an instructional approach involving students in complex authentic tasks, technology can support the kind of transformation of student learning that is at the heart of educational reform.

Given this difficulty, attempting to target one specific technology purchased with State funds and determine its effectiveness or its impact on specific student learning is probably a futile task. Another avenue of study must be found.

Identifying Technology-Rich Schools

The concept of technology-rich environments is not new. It has been used to evaluate the effectiveness of technology implementation in schools (Grimm, 1996), and in special classrooms (Apple Computer, 1995). The harder part, however, is actually defining what "technology-rich" means. Earlier studies have reported the technology that was available and compared the results with places where there was less, but specific designations of different levels of richness have been difficult to find.

A new report compiled by the CEO Forum, a study group pulled together by President Clinton, moves strongly in this direction. A recent study by Quality Education Data (QED, 1997), in addition to other sources, has been used as the basis for one attempt at defining the comparative status of different schools in the United States. The QED Survey compiled data on the status of educational technology acquisitions from across public schools in the United States. Other studies referenced in the Forum report deal with the level of technology use in the schools and the potential benefits of that use.

The "School Technology and Readiness Report", or STaR (CEO Forum, 1997), breaks the cited data into four levels of technology implementation and presents them as school profiles. The report encourages states and localities to use the levels and their descriptors to gauge their progress toward implementing technology in their schools. The profiles are structured around the "Four Pillars" of President Clinton's Technology Literacy Challenge, plus an expectation that the four main components will be integrated into the classroom (CEO Forum, 1997).

The pillars are the four major parts of the structure. *Hardware* refers specifically to computers and reports the number of students per computer, per multimedia computer, and per CD-Rom. The availability of computer maintenance services concludes the section. These are important components of the hardware question, but do not take into account the assorted other technologies available to schools that have been supplied by the Commonwealth, such as scientific probes and graphing calculators. Given that the majority of State funding appears to have been used to purchase computer hardware, however, this may not be an important drawback. In addition, the measure does reflect the national scene and gives a comparative base from which schools in Virginia could be classified. For future reference, the STaR report does note that there is a need to include more detail on the maintenance item and information regarding availability of specific computer peripherals in schools.

Connectivity covers whether the school has access to local area networks (LAN) and/or the Internet, as well as the speed of the connections. These areas directly address some of the issues raised in the earlier V.E.T.A.C. report on evaluating the Six-Year Plan (Johnston, Uhlig and White, 1997).

Content refers to the availability of resources, defined as different types of software. These include drill and practice, creativity, simulation, and research packages, as well as access to networked communications.

The final pillar, *Staff Development* recognizes the importance of the competence level of the educational professionals who are expected to use technology in the classroom. Indicators include teacher training, experience with technology, and the availability of technical support to provide assistance for those who need help from time to time.

These components are all pulled together in the last area, *Integration*, and refer to the elements of successful technology use. This integration, according to the report, is critical. It will be accomplished by committed educators who are strong supporters and models for technology use in their schools. These people will be supported by a clear set of educational objectives/expectations and will accomplish their technology goals through the implementation of the four pillars.

As a result of the research conducted, the report breaks out four levels of technology environments exemplified by the schools. "Low Tech" schools are characterized by outdated hardware and scanty availability of maintenance support, low connectivity, older digital content, staff development aimed at entry level skills, and minimal levels of technology integration into the classroom. Current data indicate that some 59% of the schools in the country fall into this category.

"Mid Tech" schools reflect the capability of a bit more than a quarter (26%) of the nation's schools. They have a mixture of outdated and current hardware configurations and still lack rudimentary maintenance for their machines. They may have a LAN, but generally have dial-up access to the Internet. Digital content, like the hardware, is a mix of the old and newer material. Professional development is aimed at helping teachers adapt instruction, some support is available, and some teachers are using the software and the Internet with their students as they make initial attempts at integrating technology into their lessons.

"High Tech" schools are more advanced, representing about 12% of the total. Most of their computers are multimedia machines, and both LAN and dedicated line connections (ISDN or T_1) are in use. The digital content is mostly current material, and professional development deals with more advanced skills and strategies. Technology integration is supported by extended class times and teachers work with students to facilitate their use of the materials.

The epitome of technology use comes in "Target Tech" schools. Virtually all computers are current, multimedia machines running current software appropriate to their more advanced capabilities. Professional development is aimed at helping teachers become more inventive, creative in their use of the technology available to them and their students. Teachers serve as technology guides with students, and regular use of various technology-based strategies is evident during extended class times available. Only three percent of the schools in the nation have reached this level.

In Search of Variables

The power of the STaR analysis lies in the descriptions of the different levels. The matrix described by the categories and levels permits quantification and classification for purposes of effectiveness reviews. Although there are overlaps in the cells, the overall matrix may be used to define exclusive categories for the purpose of an evaluation study. These categories, into which schools would be classified based on a review of their building capabilities and status, would serve as independent variables in an evaluation study.

Given the interests voiced by various stakeholders, other variables may include student achievement as measured by mean scale scores on Virginia's SOL tests, student attitudes toward school, and teacher and parent attitudes. Control variable related to societal context, such as socio-economic status, should also be included.

Basic Design

The central evaluation questions driving the study are:

1. "Do students attending schools with more advanced levels of technology perform better academically than those at schools with lower levels?"
2. "Do students attending schools with more advanced levels of technology have better attitudes toward school than those at schools with lower levels?"
3. "Do parents of students attending schools with more advanced levels of technology have more positive opinions of the schools than those of students at schools with lower levels?"
4. "Do staff members at schools with more advanced levels of technology have better attitudes toward their schools than those at schools with lower levels?"

In approaching the question of the impact of technology on Virginia's schools, we believe that the school should be the basic unit of analysis. All schools in the Commonwealth would be classified across four basic levels: technology richness (Low-Med-High-Target), environment (urban, suburban, rural), and SES (percentage of students with approved free-reduced meal applications).

Measurement variables should cover both academic and affective outcomes of technology implementation. Student achievement measures should focus on average student scale scores on the assorted SOL tests required in grades 3, 5, 8 and for the high school after course tests. Attitudinal data should be collected via student, parent and staff questionnaires. Data would be analyzed using a multivariate analysis of variance, with a discriminant analysis as a post-hoc treatment.

Summary/Conclusion

There is a demand for greater accountability in education generally, and Virginia's educational technology initiative is no exception. Calls for data that show the impact of the substantial investments made for hardware, infrastructure and staff development in the Commonwealth are not only justified, their absence would be cause for serious concern.

It is all but impossible to draw meaningful conclusions about how expanded technologies have affected learning by focusing on each individual initiative or purchase: issues related to the interaction of different technologies with various teaching strategies, students, teachers, and varied school climates make the situation much too complex. Looking at the

overall level of technology implementation and integration in a given school environment, however, may present a viable solution to the problem.

Little work has been published to date to define the concept of a "technology-rich" educational environment in concrete terms. The CEO Forum has, however, compiled data from the QED national study and other research to present a set of classifications of technology implementation in the nation's schools. Using that classification scheme and a multi-variate design/analysis, it should be possible to develop a study that will provide information related to the status of student achievement and school community opinion/perceptions of the effectiveness of technology in facilitating learning in Virginia's schools.

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